

# **Student Materials Packet**

## **Medical Response to Chemical Warfare and Terrorism 2000**

### **5, 6 & 7 December 2000**

#### **Introduction**

On behalf of the United States Army Medical Research Institute of Chemical Defense, we would like to welcome you to this live three-day program. Whether you're watching this broadcast live via satellite, through a video teleconferencing link, at our special Internet simulcast sites, or via videotape, you will be pleased to know that you are part of a large viewing audience that is scattered throughout all fifty states in the U.S.

The course will be presented over three afternoons. Sessions will focus on topics such as chemical agents and the proper medical responses in the event of intentional or accidental chemical agent exposure, battlefield management, decontamination of casualties, and personal protective equipment. Discussions on antiterrorism will be integrated throughout the program. We will feature discussions with world-renowned scientists, researchers, clinicians and counterterrorism experts.

#### **Objectives**

At the end of the program you should be able to:

- list the 4 major chemical agent classes and discuss the key effects of each on the human organism.
- identify the key elements of pre-hospital medical management for each of the 4 major chemical agent classes.
- identify cutting edge diagnostics and therapeutics for vesicants and nerve agents.
- identify and describe each of the three tiers of response to a disaster.

#### **About This Packet**

The guide is designed to assist participants in successfully completing the course. It provides information on the daily activities of the course as well as how to take the examination. The section on **Making the Most of the Broadcast** will assist those individuals new to distance learning in achieving course objectives. The **Resources for Learning** section will inform you of the variety of on-line materials available for reference. In addition, the resources include a series of quick reference guides on chemical agents and chemical defense equipment.

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# **UNDERSTANDING YOUR CONTINUING MEDICAL EDUCATION**

## **Sponsored by the U.S. Army Medical Command**

The following information is provided to help you understand the number of credits that are being offered as well as the specific accreditation statement that will appear on your course certificate.

### **Accreditation Statement**

The U.S. Army Medical Command is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians. The U.S. Army Medical Command takes responsibility for the content, quality, and scientific integrity of this CME activity.

### **Credit Designation**

The U.S. Army Medical Command designates this educational activity for a maximum of **12 hours in category 1 credit towards the AMA Physician's Recognition Award**. Each physician should claim only those hours of credit that he/she actually spent in the educational activity.

### **Statement of Need**

The planning committee for this activity has determined that an important need exists to provide military medical personnel (physicians, nurses, physicians' assistants, and certain corpsmen) with the information that they can use to manage chemical agent casualties, both in the field and in a fixed facility. The course is also required for medical personnel at depots where chemical agents are stored.

### **Learning Objectives**

At the conclusion of this activity, participants should be able to:

- list the 4 major chemical agent classes and discuss the key effects of each on the human organism.
- identify the key elements of pre-hospital medical management for each of the 4 major chemical agent classes.
- identify cutting edge diagnostics and therapeutics for vesicants and nerve agents.
- identify and describe each of the three tiers of response to a disaster.

### **Intended Audience**

This educational activity is designed to provide military medical personnel (physicians, nurses, physicians' assistants, and certain corpsmen) with information that they can use to manage chemical agent casualties, both in the field and in a fixed facility.

**Disclosure of Faculty Relationships**

As a sponsor accredited by the ACCME, it is the policy of the U.S. Army Medical Command to require the disclosure of the existence of any significant financial interest or any other relationship a faculty member or a sponsor has with the manufacturer(s) of any commercial product(s) discussed in an educational presentation. For this educational activity, no faculty reported any information to disclose.)

**Disclosure of Unlabeled/Unapproved Uses of Drugs or Devices (NA)****Acknowledgment of Commercial Support**

There is no commercial support associated with this educational activity.

# **COURSE AGENDA MEDICAL RESPONSE TO CHEMICAL WARFARE AND TERRORISM 2000**

**Presented by  
U.S. Army Medical Research Institute of Chemical Defense  
Aberdeen Proving Ground, Maryland**

**Course Director: COL Charles G. Hurst, MC**

**The agent segments listed below will include discussion of:** the history of the agent development and use, its physical properties, mechanism of action, and clinical effects and treatment. Interviews with clinicians who have treated exposures as well as interviews with scientists researching medical countermeasures and case studies or scenarios will be presented. Each day will conclude with a LIVE call-in session to a panel of respected experts who will discuss audience questions and concerns.

## **5 DECEMBER 2000**

Presents an overview of **Pulmonary Agents** and **Vesicants**

### **Pulmonary Agents**

- History
- About the Agents
- Clinical and Scientific
- Scenario
- Summary
- Counterterrorism

### **Vesicants (Particularly Sulfur Mustard)**

- History
- About the Agents
- Clinical and Scientific
- Scenario
- Summary
- Counterterrorism

**Live Panel Question and Answer Period**

# **COURSE AGENDA MEDICAL RESPONSE TO CHEMICAL WARFARE AND TERRORISM 2000**

**6 DECEMBER 2000**

**The agent segments listed below will include discussion of:** the history of the agent development and use, its physical properties, mechanism of action, and clinical effects and treatment. Interviews with clinicians who have treated exposures as well as interviews with scientists researching medical countermeasures and case studies or scenarios will be presented. Each day will conclude with a LIVE call-in session to a panel of respected experts who will discuss audience questions and concerns.

Presents an overview of **Nerve Agents** and **Cyanide**

## **Nerve Agents**

- History
- About the Agents
- Clinical and Scientific
- Scenario
- Summary
- Counterterrorism

## **Cyanide**

- History
- About the Agents
- Clinical and Scientific
- Scenario
- Summary
- Counterterrorism

## **Live Panel Question and Answer Period**

# **COURSE AGENDA MEDICAL RESPONSE TO CHEMICAL WARFARE AND TERRORISM 2000**

**7 DECEMBER 2000**

**The agent segments listed below will include discussion of:** the history of the agent development and use, its physical properties, mechanism of action, and clinical effects and treatment. Interviews with clinicians who have treated exposures as well as interviews with scientists researching medical countermeasures and case studies or scenarios will be presented. Each day will conclude with a LIVE call-in session to a panel of respected experts who will discuss audience questions and concerns.

Presents discussions on **Field Management** and **Antiterrorism**

## **Field Management**

- Decontamination
- Protection, Individual and Collective
- Triage
- Evacuation
- Summary
- Scenario
- Counterterrorism

## **Antiterrorism**

The antiterrorism segment will include discussion of the structure, operations, and capabilities of crisis and consequence management organizations with reference to both military and domestic preparedness perspectives.

## **Live Panel Question and Answer Period**

## **Final Examination**

## MAKING THE MOST OF THE SATELLITE BROADCAST

### **Attend All Three Days of the Broadcast**

It is important to attend and participate in all three days of the broadcast. Your attendance at all three days is **required** for certification.

### **Ask Questions**

At the end of each day, you will be able to interact with our experts. Fax in your questions throughout each day or call in your questions during the live call in session. Ask your site facilitator for Call-In and Fax-In Sheets.

You might also want to make use of the on-line discussion board. Visit <http://ccc.apgea.army.mil> and click on the banner at the bottom of the page. Then click on the link for the discussion board.

### **Utilize the On-Line Discussion Board**

Posting your question on the discussion board will allow for interaction between you and other participants in the class. Our instructors will be monitoring and contributing to the discussion area throughout the live broadcast.

### **Sample Examination Questions**

Contained in this guide on page 8, you will find 5 sample examination questions. Completing the sample test questions will allow you to test your knowledge of the course material prior to taking the examination. See the **Sample Exam Questions** on page 8 in the Resources for Learning Section of this packet.

### **Complete the Course Evaluation and Examination**

Your comments about the broadcast are collected in the course evaluation. The course evaluation feedback will assist us in planning for future broadcasts as well as to develop future distance learning products. We value your opinion and look forward to your review of the broadcast. Once you have completed the course evaluation, please complete the course examination. Remember, you are **required** to complete the examination in order to receive credit for the course.



## RESOURCES FOR LEARNING

### Textbook, Handbooks, Additional Publications

There are several on-line resources for learning available at <http://ccc.apgea.army.mil>. Once at the site, click on the link for 2000 Satellite Broadcast. Next, click on the link for Course Materials. The on-line Resources for Learning include:

- **Textbook of Military Medicine Medical Aspects of Chemical and Biological Warfare** - This volume of the textbook was prepared for military medical educational use. The purpose of the textbook is to make the reader aware of the threats of chemical and biological weapons and how to respond to them. The main focus of the textbook is the medical management of chemical and biological casualties.  
**Note:** This version of the textbook is best viewed on the web. If you are interested in a hard copy of the text, please see the Educational Products sheet under the Course Materials link.
- **Medical Management of Chemical Casualties Handbook** - The handbook provides medical personnel in the field with a concise, pocket-sized reference source for the medical management of chemical casualties.  
**Note:** This version of the handbook is best viewed on the web. If you are interested in a hard copy of the text, please see the Educational Products sheet under the Course Materials link.
- **Field Management of Chemical Casualties Handbook** - The handbook provides military and civilian emergency response personnel in the field with a concise, pocket-sized reference source for the medical management of chemical casualties.  
**Note:** This version of the handbook is best viewed on the web. If you are interested in a hard copy of the text, please see the Educational Products sheet under the Course Materials link.
- **Publications on Pyridostigmine** - The following publications are available for download and print at <http://ccc.apgea.army.mil>. Click on the Reference Materials Link.
  - Defense Against Toxin Weapons
  - USAMRICD Special Publication 98-01: Pyridostigmine (LTC James M. Madsen)
  - USAMRICD Technical Memorandum 90-4: Pyridostigmine (Frederick R. Sidell, M.D.)
  - Interactions Between Nerve Agent Pretreatment and Drugs Commonly Used in Combat Anesthesia
  - Pyridostigmine Used as a Nerve Agent Pretreatment Under Wartime Conditions

## **SAMPLE EXAM QUESTIONS**

- 1. Of the following, the earliest indicator of pulmonary edema in a casualty exposed to a respiratory agent is:**
  - a. An abnormal arterial-blood-gas (ABG) test
  - b. Dyspnea (shortness of breath)
  - c. A pattern of scattered infiltrates with Kerley B lines on PA and lateral chest radiographs
  - d. Dullness to percussion on physical examination
  - e. Wheezing
  
- 2. In a person severely intoxicated by nerve agent, atropine administration should be titrated to which of the following?**
  - a. Clinical reduction of bronchospasm and secretions
  - b. Clinical restoration of normal heart rate and blood pressure
  - c. Clinical reduction of skeletal muscle fasciculations and twitching
  - d. Clinical reduction of gastrointestinal distress and spasm
  - e. Clinical resolution of miosis and eye pain
  
- 3. Someone with severe systemic effects from a nerve agent should initially receive:**
  - a. Three MARK I kits
  - b. One Diazepam
  - c. Three MARK I kits and diazepam
  - d. One MARK I kit
  - e. Three Mark I kits and an additional 2 mg of atropine
  
- 4. Decontamination should be performed**
  - a. Inside the receiving medical facility (e.g., ER)
  - b. Downwind from the receiving medical facility
  - c. Before any medical care is rendered
  - d. By fully qualified medical personnel
  
- 5. A cyanide casualty who is not breathing but still has a pulse just entered your Battalion Aid Station. He/she:**
  - a. Should be given the three separate antidotes in the military cyanide antidote kit.
  - b. Should receive sodium thiosulfate followed by sodium nitrite.
  - c. Should be considered expectant.
  - d. Should immediately have blood drawn to determine the level of cyanide in the blood.
  - e. Should be given sodium nitrite followed by sodium thiosulfate.

## SAMPLE EXAM QUESTION ANSWERS

1. **The answer is B.** Swelling in the tissues between the airspaces (alveoli) and capillaries causes stiffness and impaired gas exchange. It is perceived by the affected individual as shortness of breath but is not usually heard or seen by the clinician on clinical exam or x-ray.
2. **The answer is A.** Atropine reverses nerve agent induced stimulation of the muscarinic receptors but not the nicotinic receptors. The most critical muscarinic systems are in the airways and excess stimulation of them is marked by bronchospasm (asthma-like) and excess secretions. Reduction of the spasm and secretions are readily appreciated as improved ventilation.
3. **The answer is C.** This is standard military doctrine. The logic is that a severe nerve agent casualty has enough agent on board to need at least 6 mg atropine and full dose oxime immediately. The diazepam is given even if the casualty is not seizing because that casualty is likely to seize. In reality, the severely intoxicated casualty will probably need more than 6 mg atropine, and if he/she does seize, will need more than 10 mg diazepam. Medics expecting to treat these casualties carry additional atropine and diazepam injectors.
4. **The answer is B.** It is most important to avoid cross contamination (spreading the agent to non-contaminated personnel) and to avoid contaminating the health care facility. It is best if decontamination is done outside the facility and downwind, meaning the wind blows contaminants away from the health care facility toward the decontamination point.
5. **The answer is E.** Respiration is lost nearly immediately after high dose cyanide intoxication occurs, but the casualty is fully recoverable as long as the heart continues to beat. The military antidote kit does not contain amyl nitrite as does the civilian kit. Both contain sodium nitrite (methemoglobin former) and sodium thiosulfate (sulfur donor). In pure cyanide intoxication, both are given in the order listed. If amyl nitrite is available, it is given earliest, as the others are prepared for infusion. It can be administered to a non-breathing casualty through bag and mask.

## AGENT SCENARIOS

### **Pulmonary Agents**

A pulmonary agent casualty presents to the Battalion Aid Station (BAS) for care and manifests early symptoms. The first scene shows incorrect management of the casualty. The discussion includes a demonstration of correct casualty management. **Issues discussed** focus on medical care. In the non-battlefield setting, other issues might include identification/selection of potential injured from a population of worried residents, source of agent, criminal investigation, evacuation, and others.

### **Nerve Agents**

A liquid nerve agent casualty presents to the BAS for care and manifests severe symptoms. **Issues discussed** focus on medical care, but others include appropriate self-protection by health care personnel and decontamination of the casualty.

### **Field Management**

A field treatment site receives casualties of several different exposures, including conventional wounds and psychogenic. The camera focuses on the medic triaging 6 of the casualties to demonstrate the triage categories and different agents/routes of exposure. **The discussion** asks the viewer to triage the 6 and to justify the resultant order.

### **Cyanide**

Firefighters respond to a building fire and notice casualties in a stairwell remote from the fire. The disconnect triggers a consideration of a HAZMAT incident. At onset, the culprit is seen releasing the chemical and setting the fire. **Issues discussed** focus on medical care, but others raised include appropriate method of agent deployment, threat to first responders (secondary device), and decisions required by incident commander.

### **Sulfur Mustard**

Soldiers on dismounted reconnaissance encounter liquid and vapor sulfur mustard. Two are casualties, although the injuries of only one are visible within the time frame of the movie. **Issues discussed** focus on medical care, but others include appropriate tactical use of a persistent agent and the hard choices a squad leader faces in balancing mobility against protection.

# LEAST YOU NEED TO KNOW ABOUT CHEMICAL AGENTS

## THE LEAST YOU NEED TO KNOW ABOUT PULMONARY AGENTS

### PULMONARY AGENTS:

- Chlorine
- Phosgene (CG)
- HC smoke
  - HC smoke is the standard, white obscurant smoke fielded by the military in smoke grenades and artillery rounds. The nitrate-based explosives used by the military generate oxides of nitrogen.
- Oxides of Nitrogen
- PFIB
  - Perfluoroisobutylene (PFIB) is a toxic pyrolysis product of “Teflon”. The electrical wiring found in military vehicles and aircraft is insulated with Teflon polymers.

**STATE:** Gas

**ROUTE OF EXPOSURE:** Inhalation

**EFFECTS:** Local

### TIME COURSE OF EFFECTS:

- There is a latent period between exposure and onset of symptoms.
- The onset of pulmonary symptoms within four hours after exposure to any pulmonary agent indicates a severe and potentially fatal exposure.
- Late complications include: secondary pneumonia, fibrotic changes (HC, NO<sub>x</sub>).
- Complications: pneumonia, fibrotic changes (HC, NO<sub>x</sub>).

**MANAGEMENT:** rest, observation, evacuation, PPV with PEEP and fluid resuscitation.

### KEY POINTS ABOUT PULMONARY AGENTS:

- The lung is the most important route of exposure for chemical warfare agent (CWA) because:
  - CWA are most often dispersed as gases, vapors or aerosols that are easily inhaled.
  - The surface area available for exposure to CWA is 50-100 times greater in the lung than on the skin.
  - Penetration of CWA into the systemic circulation is more rapid via the lung than the skin.
- Pulmonary-agent effects are local, not systemic. They produce tissue damage at the site of contact in the lung.
- Pulmonary agents that act on the Central airways, like sulfur mustard:
  - Are highly reactive or highly water soluble compounds.
  - Produce inflammation, necrosis and acute obstructive problems like laryngospasm, bronchospasm, pseudomembranes.
  - Usually produce early clinical signs and symptoms, such as coughing, pain, hoarseness, stridor, wheezing.

- Pulmonary agents that act on the Peripheral airways, like phosgene:
  - Are only weakly reactive or soluble.
  - Produce non-cardiogenic pulmonary edema.
  - Are associated with a latent period, of sometimes many hours, between exposure and onset of symptoms.
  - Produce no early clinical signs of exposure.
- Chlorine is intermediate in its solubility and reactivity and, therefore, produces effects in both lung compartments.
- High-dose exposure to any of the pulmonary agents can produce effects in both lung compartments.
- Chlorine and phosgene are true gases at standard temperature and pressure, and are heavier than air. Phosgene has an odor of fresh-cut grass or hay, or green corn.
- The combustion of halogenated hydrocarbon compounds releases toxic precursors like phosgene.
- Of all the CW and BW agents, phosgene and chlorine have the greatest potential for terrorist use because:
  - They are used extensively in industry and are, therefore, readily available and accessible in lethal quantities.
  - They are easily dispersed without the use of a weapon system.

#### **TREATMENT FOR PULMONARY AGENT EXPOSURE:**

- Treatment for exposure to a peripheral pulmonary agent includes:
  - Bedrest, supplemental oxygen, observation for at least 6 hours.
  - Positive airway pressure in the form of positive end expiratory pressure (PEEP) or continuous positive airway pressure (CPAP) to keep alveoli expanded, limit or reverse transudation of fluid, and thereby improve diffusion of gases across the alveolar-capillary membrane.
- The potential requirement for intubation and positive pressure ventilation to maintain adequate oxygenation.
- Transudation of fluid across the alveolar-capillary membrane following phosgene exposure creates intravascular volume depletion. Casualties will require volume resuscitation. Diuretics should be avoided.
- Fifteen per cent of the population possesses hyperreactive airways. Following exposure to pulmonary agent, casualties with preexisting, overt or latent reactive airways disease will:
  - Likely present first for care (ie. shorter latent period).
  - Have symptoms of bronchospasm in addition to agent effects.
  - Require the addition of bronchodilators and, possibly, steroids to the treatment regimen.

#### **ANSWER THESE QUESTIONS ABOUT PULMONARY AGENTS:**

- What are the main pillars of management for pulmonary agents?
- What are we going to do medically at a higher echelon of care?
- Differentiate pulmonary agents from mustard and Lewisite.
- What agents are considered pulmonary agents?

## THE LEAST YOU NEED TO KNOW ABOUT CYANIDE

### CYANIDE AGENTS:

- Hydrogen cyanide (AC)
- Cyanogen chloride (CK)

### STATE:

- Below 78<sup>0</sup> F: liquid and vapor
- Above 78<sup>0</sup> F: gas

### ROUTE OF EXPOSURE:

- Inhalation (battlefield and terrorist)
- Percutaneous
- Ingestion

**EFFECTS:** Systemic

**TIME COURSE OF EFFECTS:** Very rapid for large inhaled doses

**OTHER DIAGNOSES:** nerve agents, heart attack, epilepsy

### KEY POINTS ABOUT CYANIDE AGENTS:

- Even though it's called a "blood" agent, cyanide actually does most of its dirty work inside cells rather than in the blood and that it shuts down cellular respiration and produces histotoxic anoxia.
- Cyanide likes to react with metals (such as the iron in methemoglobin) and sulfur. This explains how the antidotes work!
- Some antidotes provide metals to react with cyanide, and one supplies sulfur. What antidotes provide a metal to cyanide?

#### **Metal providers:**

- Amyl nitrite
- Sodium nitrite
- 4-DMAP, dicobalt edetate, hydroxycobalamin

#### **Sulfur donor:**

- Sodium thiosulfate
- The two major antidotes for cyanide are sodium nitrite and sodium thiosulfate. If you had only one of these to choose from, which would you choose? (thiosulfate)
- Like the pulmonary agents, cyanide is more of a terrorist threat than a battlefield threat.

### ANSWER THESE QUESTIONS ABOUT CYANIDE:

- What makes cyanide different from the preceding pulmonary agents?
- What else can drop you as quickly as cyanide does, and how would you tell the difference?
- At what temperatures will cyanide change state?
- Name the agents that fall within the cyanide category.
- What are the clinical effects of cyanide?
- What antidotes are used to stop the effects of cyanide and how do they work?

## THE LEAST YOU NEED TO KNOW ABOUT VESICANTS

### VESICATING AGENTS:

- Sulfur mustard (H, HD)
- Lewisite (L)
- Phosgene oxime (CX)

**STATE:** solid (below 58° F), liquid, and vapor

**ROUTE OF EXPOSURE:** All (especially inhalation, skin, and eye)

### EFFECTS:

- Local (respiratory tract, eyes, and skin)
- Systemic

**TIME COURSE OF EFFECTS:** Latent period for mustard; inversely correlated with dose

**OTHER DIAGNOSES:** No latent period for Lewisite or phosgene oxime.

### MANAGEMENT:

- Dimercaprol (BAL) only for Lewisite
- Early decontamination
- Symptomatic treatment for sulfur mustard and phosgene oxime

### KEY POINTS ABOUT VESICANTS:

- Even though soldiers realized that mustard was a liquid as well as a vapor, the old term *poison gas* was so firmly entrenched that people called this agent *mustard gas*—and still do, incorrectly.
- It is important to know that mustard is a very powerful alkylating agent; that is, it binds strongly to various molecules in the body. Its binding to DNA and related molecules leads to its radiomimetic effects—the effects that are like those from radiation.
- Systemic *absorption* occurs even from a small dose of mustard, but acute systemic *effects* are seen only when the dose is high.
- The mechanism of mustard deaths is usually respiratory and occurs in three basic peaks: one from laryngospasm or from airway obstruction in the first 24 hours, another in the next couple of days from secondary bacterial pneumonia, and a third several days later from septic pneumonia.
- LD<sub>50</sub> for sulfur mustard: 7 g (about 1 teaspoon)

### ANSWER THESE QUESTIONS ABOUT VESICANTS:

- What makes sulfur mustard different from the earlier agents?
- In what PHYSICAL STATES will we encounter mustard?
- About how much liquid mustard does it take to kill? And how much liquid mustard would it take to kill if the entire dose was absorbed?
- What are possible routes of entry of vesicants into the body?
- Are mustard effects local or systemic?
- Is there a latent period for mustard, and if so what clinical information does that give you?
- Do we have any antidotes for the vesicating agents?



## THE LEAST YOU NEED TO KNOW ABOUT NERVE AGENTS

### NERVE AGENTS:

- G agents: GA (tabun), GB (sarin), GD (soman)
- VX

### STATE:

- G agents: liquid and vapor
- VX: liquid

### ROUTE OF EXPOSURE:

- Respiratory tract
- Skin
- Eye

### EFFECTS:

- Brain: seizures
- Skeletal muscle: twitching, fasciculations → paralysis
- Smooth muscle: pinpoint pupils, chest tightness, nausea/vomiting/cramping
- Exocrine glands: "wet all over"

### TIME COURSE OF EFFECTS:

- Vapor: short onset
- Liquid: delay

### OTHER DIAGNOSES: Cyanide

### MANAGEMENT:

- Atropine
- 2-PAM chloride
- Diazepam

### DOSAGE:

- Severe exposure = 3 Mark I kits (atropine + 2-PAM chloride) + diazepam; additional atropine as needed.

### ANTIDOTAL ENHANCEMENT: Pyridostigmine bromide

### KEY POINTS ABOUT NERVE AGENTS:

- The G agents are typically liquids that produce vapor, whereas VX is a persistent liquid about the consistency of motor oil.
- Body sites, or routes of entry, include skin contact for both kinds of agents and inhalation of G-agent vapor.
- The time from exposure to clinical effects varies depending upon the state of the agent and the route of exposure. But exposure by any route to a massive dose of either liquid or vapor can present initially with sudden collapse, cessation of breathing, and convulsions. Does this sound familiar? Is there another agent that can present like this? [cyanide]
- Atropine is a competitive inhibitor of acetylcholine at muscarinic sites
- Imagine atropine coating the smooth muscle or the gland so that even though there are still too many green dots in the space, not many can get through.

- As a *carbamate* anticholinesterase, pyridostigmine binds *reversibly* with Pacmen. The principle here is that by filling beforehand the mouths of a quarter or so of the Pacmen we create a reserve force that will then spit out the pyridostigmine later and be available to gobble up more green dots again.
- Because pyridostigmine is a charged molecule, it normally doesn't cross the blood-brain barrier. That's a real plus when you give pyridostigmine to, for example, pilots.
- Atropine doesn't work at nicotinic sites because it can't fit at those sites.
- The second antidote is 2 PAM CHLORIDE, also known as the 2-PAM *crowbar*, because it pries the nerve agent out of the mouth of the Pacman, as long as you use the crowbar before the glue sets.
- Diazepam, isn't really a specific antidote for nerve-agent poisoning at all, but just raises the seizure threshold.
- The dosage regimen for SEVERE EXPOSURE to nerve agent is 3 MARK Is (atropine + 2 PAM) and a diazepam initially, then atropine every 5-10 minutes. The endpoint is drying secretions or improved ventilation.
- Pyridostigmine is a charged molecule, it doesn't cross the BBB.
- LD<sub>50</sub> (VX): 10 mg (a pinhead)

#### **NERVE AGENT ACTION:**

- Remember that normal cholinergic neurotransmission involves release of the neurotransmitter *acetylcholine*—the little green dots of our graphics—and that the green dots cross a space to get to the end organ, which can be another nerve cell, a skeletal muscle, a smooth muscle, or an exocrine gland. Normally, the enzyme *acetylcholinesterase*—the orange Pacmen of our animation—inactivates or gobbles up the green dots.
- Nerve agents irreversibly bind to acetylcholinesterase; that is, they stick in the mouths of the Pacmen. At this point, the Pacman won't be able to spit out the nerve agent by itself, but at least one of our antidotes (the oxime) can pry the nerve agent out of the Pacman's mouth. However, after a time, the glue, so to speak, sets, a process that we call aging. Then, not even our the oxime can pry the nerve agent out of the mouth of the Pacman.
- Now when the mouths of the Pacmen are full, green dots accumulate and overstimulate the end organs. Hyperstimulation, though, is eventually followed by fatigue and organ failure.
- Reviewing this is important because understanding how nerve agents work helps us understand both their clinical effects and our antidotal treatment.

#### **ANSWER THESE QUESTIONS ABOUT NERVE AGENTS:**

- What are the two major types of nerve agents?
- How much liquid, say, VX, does it take to kill?
- Knowing what you know about the mechanism of action of nerve agents, what will be their effects when the end organs are other neurons, say in the brain? Effects on skeletal muscle? What about smooth muscle? And exocrine glands?
- Looking at the time course of effects, is there a latent period associated with nerve agent exposure?
- For a massive exposure, what's the dosage regimen?

## QUICK REFERENCE TABLES



## QUICK REFERENCE GUIDE TO CHEMICAL AGENTS

Type of Agent	Effects	Onset	Signs and Symptoms	Immediate Management	Skin Decontamination	Detection
<b>Pulmonary: CG (PFIB) HC</b>	Dyspnea, coughing	Hours	Eye and airway irritation, dyspnea, chest tightness, and <b>delayed</b> pulmonary edema.	Termination of exposure, ABCs of resuscitation, enforced rest and observation, oxygen with or without positive airway pressure for signs of respiratory distress, other supportive therapy as needed.	<b>Vapor</b> - fresh air <b>Liquid</b> - copious water irrigation.	The MINICAMS, Monitox Plus, Draeger tubes, Individual Chemical Agent Detector (ICAD), M18A2, M90, and M93A1 Fox will detect small concentrations of phosgene. The M256A1 detector kit, chemical-agent detector paper (M8 paper, M9 paper) and ICAM will not detect phosgene.
<b>Cyanide: AC, CK</b>	Loss of consciousness, convulsions, apnea	Seconds	<b>After exposure to high dose:</b> seizures, respiratory and cardiac arrest.	<b>Antidote:</b> intravenous (IV) sodium nitrite and sodium thiosulfate. <b>Supportive:</b> oxygen, correct acidosis	None usually needed	The M256A1 detector ticket detects hydrogen cyanide (AC) as vapor or gas in the air, and the M272 kit detects cyanide in water. The ICAD, M18A2, and M90 detectors also detect AC. The ICAM, M22, M8A1 automatic chemical agent alarm (ACAA), and M8 and M9 paper do <b>not</b> detect cyanide.
<b>Vesicants: H, HD</b>	Erythema, blisters, irritation of eyes; cough, dyspnea	Hours	Asymptomatic latent period (hours). Erythema and blisters on the <b>skin</b> ; irritation, conjunctivitis, corneal opacity, and damage In the <b>eyes</b> ; mild upper respiratory signs to marked <b>airway</b> damage; also gastrointestinal (GI) effects and bone marrow stem cell suppression.	Decontamination immediately after exposure is the only way to prevent damage. Supportive care of patients. There is no specific therapy.	0.5% hypochlorite, M291 kit, and water in large amounts	M256A1, M272 water testing kit, MINICAMS, M18A2, M21 remote sensing alarm, M90, M93A1 Fox, Bubbler, ICAM, and DAAMS, M8 paper, or M9 paper. M22 ACADA detect vesicants. ( <b>NOT</b> the M8A1 automatic chemical agent alarm)

## QUICK REFERENCE GUIDE TO CHEMICAL AGENTS

Type of Agent	Effects	Onset	Signs and Symptoms	Immediate Management	Skin Decontamination	Detection
<b>Lewisite: L</b>	Erythema, blisters, irritation of eyes; cough, dyspnea	Immediate	Lewisite causes immediate pain or irritation of skin and mucous membranes. Erythema and blisters on the skin and eye and airway are similar to those seen after mustard exposures.	Immediate decontamination; symptomatic management of lesions the same as for mustard lesions; a specific antidote (BAL) will decrease systemic effects.	M291, 0.5% hypochlorite, water in large amounts.	M22, M9, M256A1 kit, M272 water testing kit, MINICAMS, M18A2, M21 remote sensing alarm, M90, M93A1 Fox, Bubbler, ICAM, and DAAMS (but <b>NOT</b> the M8A1 automatic chemical agent alarm).
<b>Nerve Agents: GA, GB, GD, GF, VX</b>	Vapor: miosis, rhinorrhea, dyspnea Liquid: sweating, vomiting Both: convulsions, apnea	<b>Vapor:</b> Seconds  <b>Liquid:</b> Minutes to Hours	<b>Vapor:</b> miosis, rhinorrhea, dyspnea  <b>Liquid:</b> Sweating, vomiting  <b>Both:</b> convulsions, apnea	Administration of MARK I Kits (atropine and pralidoxime chloride); diazepam. If casualty is severe; ventilation and suction of airways for respiratory distress.	M291, M258A1, 0.5% hypochlorite, large amounts of water.	M256A1kit, CAM, M9 paper, M8A1, M22 ACADA alarm systems, M90, Draeger, M272 Water Test Kit, M18A2, and the M93A1 FOX.

## PHYSICAL PROPERTIES OF CHEMICAL AGENTS

Symbol	Appearance and Notes
GA	Clear, colorless, and tasteless liquid, chemically similar to organophosphate pesticides such as Malathion or Parathion. Has a slightly fruity odor. Solubility: miscible with water (H <sub>2</sub> O)
GB	Clear, colorless, and tasteless liquid. Has a faintly sweet smell. Odorless in vapor and pure form. Solubility: miscible in water
GD	Clear, colorless, and tasteless liquid. Has slight camphor odor and gives off a colorless vapor.
GF	Liquid with sweet or musty odor of peaches.
VX	Oily liquid that is clear, odorless, and tasteless. It is amber colored similar in appearance to motor oil. Moderate solubility in water.
V <sub>x</sub>	Liquid with faint fishy odor
H and HD	Liquid is colorless when pure, but it is normally a yellow to brown oily substance. Vapor is colorless with a slight garlic or mustard like odor. Sparingly soluble in H <sub>2</sub> O; freely soluble in organic solvents.
HT	A mixture of 60% HD and 40% T. T is a sulfur, oxygen and chlorine compound similar to HD and is a clear yellowish liquid with a slight garlic or mustard like odor. Insoluble in water.
HN-1	Oily, colorless to pale yellow with a faint, fishy, or musty odor. Soluble in organic solvents.
HN-2	Pale amber to yellow oily liquid; fruity odor in high concentrations; smells like soft soap with a fishy smell in low concentrations. Soluble in organic solvents.
HN-3	Colorless to pale yellow liquid with a butter almond odor; most stable in storage of the three nitrogen mustards. Insoluble in water; soluble in organic solvents.
L	In a pure form Lewisite is a colorless and odorless liquid, but usually contains small amounts of impurities that give it a brownish color and an odor resembling geranium oil. It is heavier than mustard, poorly soluble in water but soluble in organic solvents.
HL	Dark oily liquid giving off a colorless vapor. Has garlic-like odor from its HD content. Insoluble in H <sub>2</sub> O
CX	May appear as a colorless, low-melting point (crystalline) solid or as a liquid. It has a high vapor pressure, slowly decomposes at normal temperatures; it has a disagreeable, penetrating odor.
CG	Fog-like in its initial concentration, but it becomes colorless as it spreads; it has both a newly mown hay or green corn odor and a highly toxic suffocating odor. Extremely volatile and nonpersistent agent.
DP	Colorless liquid. It has a newly mown hay or green corn odor.
AC	Nonpersistent, colorless liquid that is highly volatile. It has a faint odor similar to bitter almonds that sometimes cannot be detected even at lethal concentrations.
CK	Colorless gas with a sharp, pepperish odor similar to that of most tear gasses. The odor of CK often goes unnoticed because it is so irritating to the mucous membranes. Slightly soluble in H <sub>2</sub> O
DM	Light green to yellow crystals at room temperature; irritates nasal passages similar to pepper; no odor, but irritating. Insoluble in H <sub>2</sub> O; Slightly soluble in common organic solvents.
DA	Colorless, crystalline, vapor odor is shoe polish, vapor color is white or gray
DC	Colorless, solid, vapor odor is garlic, vapor color is white
CN	Colorless to gray crystalline solid with a sharp, irritating floral odor. Odor threshold for CN is 0.1 mg/m <sup>3</sup> . Insoluble in water. In pure form, colorless crystalline solid with sour or rotten fruit odor. Insoluble in water. White smoke.
CA	Clear liquid smelling like flypaper; it has an immediately strong irritating effect on the eyes and respiratory tract. May cause severe nausea.

CNS	Colorless, oily liquid with a stinging pungent odor. Insoluble in water; soluble in organic solvents.
PS	
CS	White crystalline solid; burnt to create a colorless gas with an acrid pepper-like smell.
CR	Pale yellow crystalline solid; has a pepper-like odor.
BZ	An odorless white crystalline solid. Slightly soluble in H <sub>2</sub> O; soluble in dilute acids.
LSD	Solid which is soluble in water.



## CHEMICAL DEFENSE EQUIPMENT

EQUIPMENT	WHAT IT IS	WHAT IT DOES	WHO USES IT	LIMITATIONS
M40 Mask	Full-face respirator fitted with an external mounted filter canister. The filter canister has a pleated HEPA filter and ASZ charcoal impregnated.	Protect face and respiratory tracts of the wearer against volatile agents and aerosols by removing biological and toxin agents from the ambient air.	U.S. Army, U.S. Marine Corps, and U.S. Navy	Does not filter out ammonia, carbon monoxide, nitric oxide, or carbon dioxide. Does not protect in close space when oxygen in atmosphere is below 19.5%.
Battledress Overgarment (BDO)	A two-layer, two piece chemical protective garment consisting of coat and trousers. Outer layer is water repellent treated nylon. Inner liner is polyurethane foam/nylon tricot laminate impregnated with active charcoal.	Provide dermal protection from all chemical agents vapors, liquids, droplets, and biological toxins up to 24 hours after exposure.	All U.S. Armed Forces, with the exception of specialized units.	Not effective when wet, restricts mobility, increases wearer's body temperature. Must be removed and discarded before 24- hour time limit. POL products will decrease suit effectiveness.
Joint Service Lightweight Integrated Suit Technology (JSLIST)	A two-layer, two piece chemical protective garment consisting of coat and trousers. Lighter and less bulkier than previous generations of chemical overgarments. Outer shell is a 50/50 nylon/cotton poplin ripstop with durable water repellent finish. Liner layer is no-woven front laminated.	Can be worn in all environments. Can be laundered up to six times before agent exposure. Provides dermal protection from all chemical agents vapors, liquids, droplets, and biological toxins up to 24 hours after exposure.	All U.S. Armed Forces	Not effective when wet, restricts mobility, increases wearer's body temperature. Must be removed and discarded before 24- hour time limit.
Self-Contained Toxic Environment Protective Outfit (STEPO)	Total encapsulating protective ensemble. It is the military level A suit. It has a self-contained breathing apparatus, a battery power cooling system and a hands-free communication system.	Provide protection against chemical/biological agents, missile/rocket fuels, petroleum, oils and lubricants (POL), and industrial chemicals. Provide 4 hours of self-contained breathing and cooling in highly toxic and oxygen deficient environments. Can be decontaminated for reuse after 5 vapor exposures.	Explosive Ordnance Disposal (EOD), Technical Escort Units (TEU), Ammunition handlers, and Chemical Surety Activity personnel.	Must be discarded after liquid chemical agent contamination.
Improved Chemical Agent Monitor (ICAM)	Hand-held, point source post-attack device, used for monitoring chemical agent contamination on people and equipment.	Identify mustard and nerve agents on personnel and equipment.	U.S. Army, U.S. Marine Corps, and U.S. Navy	Point source device, can give false reading due to interference; take long time to purge if probe becomes contaminated; detects only vapor.

<b>EQUIPMENT</b>	<b>WHAT IT IS</b>	<b>WHAT IT DOES</b>	<b>WHO USES IT</b>	<b>LIMITATIONS</b>
M256A1 - Chemical Detector Kit	Portable and disposable chemical agent detector kit; has 12 sampler-detectors and instruction cards, and M8 detector paper.	Test for chemical agents in the air; usually used to determine when it is safe to unmask. M8 paper is used to detect liquid chemical agents on exposed surfaces.	All U.S. Armed Forces	Does not detect Phosgene (CG); battlefield contaminants can interfere giving false readings. Five-year shelf life
M18A2 - Chemical Agent Detector Kit	Hand-held chemical sampling test kit made of detector tubes, tickets, paper substrates, and instruction booklet.	Detect and classify dangerous concentrations of toxic chemical agents in the air and liquid chemical agents on exposed surfaces. Kit is also used to collect and forward samples of unidentified toxic chemical agents to a technical intelligence team or laboratory for identification.	Technical Escort Units (TEU)	Time consuming
M9 - Chemical Agent Detection Paper (Includes M8 Paper)	Chemical treated, dye impregnated, adhesive backed paper, issued in 30-foot roll.	Produce red spots upon contact with liquid nerve agents (G and V) and blister agents (H and L).	All U.S. Armed Forces	Only detects vapor, does not identify agent, battlefield contaminants can interfere with readings.

## Personal Protection Equipment

EPA/OSHA PPE LEVEL	WHAT IT IS	WHAT IT DOES	WHO USES IT	LIMITATIONS
LEVEL A	It should be worn when the highest level of respiratory, skin, eye and mucous membrane protection is needed. Positive pressure (pressure demand), self contained breathing apparatus (NIOSH approved), or positive-pressure supplied air respirator with escape SCBA. Fully encapsulating chemical protective suit. Gloves, inner, chemical resistant. Gloves, outer, chemical resistant. Boots, chemical resistant, steel toe and shank. Two-way radio communications (intrinsically safe/non-sparking).	Provides full body coverage and positive pressure, self-contained breathing apparatus or airline respirator with escape SCBA. Protects against substances that have a high degree of hazard to the skin and/or in poorly ventilated areas.	Personnel working in area where the highest level of protection for the skin, eyes, and respiratory system is required.	High stress level due to limited visibility and mobility, and being in a highly toxic environment. Poor dexterity due to multiple layers of gloves; no thermal protection and limited radiation protection. Limited work time due to SCBA and/or total encapsulation.
LEVEL B	The minimum level recommended on initial site entries until the hazards have been further identified and defined by monitoring, sampling, and other reliable methods of analysis, and equipment corresponding with those findings utilized. Positive-pressure (pressure-demand), self-contained breathing apparatus(SCBA) (NIOSH approved), or positive-pressure supplied air respirator with escape SCBA. Chemical resistant clothing (overalls and long-sleeved jacket, coveralls, hooded two-piece chemical splash suit, disposable chemical resistant coveralls.) Coveralls (under splash suit). Gloves, outer, chemical resistant. Gloves, inner, chemical resistant. Boots, outer, chemical resistant, steel toe and shank. Two-way radio communications (intrinsically safe).	Provides maximum respiratory and mucous membrane protection and less skin protection than Level A.	First responders and initial site entry personnel.	No thermal protection, increase weight, breathing air time, and limited communications and mobility in confined area.
LEVEL C	Full-face or half-mask, air-purifying respirator (NIOSH approved). Chemical resistant clothing (one piece coverall, hooded two piece chemical splash suit, chemical resistant hood and apron, disposable chemical resistant coveralls.) Gloves, outer, chemical resistant. Gloves, inner, chemical resistant. Boots, steel toe and shank, chemical resistant. Two-way radio communications (intrinsically safe).	Provides full body coverage and an air purifying respirator. Provides limited respiratory, mucous membrane, and skin protection.	Personnel working in area where the airborne substance is known, and concentration measured.	Only provides minimal skin and respiratory system protection.
LEVEL D	Primarily work uniform and is used for nuisance contamination only. It requires only coveralls and safety shoes/boots. Other PPE is based upon the situation (types of gloves, etc.).	Only a safety work clothes.	Almost anyone not directly working in hazardous chemical environments.	Cannot be worn on any site where respiratory or skin hazards exist.



## 📋 Instructions for completing Participant Registration and Evaluation Optical Scantron Form



- Read the Privacy Act Statement, on page 32, before filling out the form.
- Please use a No. 2 pencil only. Erase completely to change a mark. Since an optical scanner reads the forms, we **cannot** accept photocopied forms. If you need additional Scantron forms, please contact the CCCD at 410-436-2230.
- Failure to complete this form will result in no course credit being given.
- Do not fold or staple anything to the scantron form.

 **Section 1: Name, SSN, Telephone Number, etc.**

- It is important you correctly enter your first name, last name and middle initial to ensure an accurate certificate.
- The SSN is used for identity purposes and prevents the assignment of more than one identification number to the same individual. If you do not wish to use your SSN, you must provide a unique identification number that you will easily remember. You may create the number by using a combination of other numbers familiar to you, for example, your telephone area code (3 digits), followed by the month of your birth (2 digits), and ending with the last 4 digits of your phone number or SSN.
- Fill in your response to the following two questions:  
How did you find out about our broadcast? (select one)  
Are you a Physician, Registered Nurse or Other (PA, LPN, medic, first responder) (select one).

[illegible]

## Section 2: Military Personnel Only

- This section should be filled out by military personnel only.
- Shade the appropriate bubbles for your service (select one), career branch (select one), and rank (select one). If your service, branch or rank are not listed, shade in the bubble for **Other**.
- Fill in your response for the following question:

**Are you PROFIS?** (A PROFIS officer is one who does something else in his/her "real" assignment, but carries vest-pocket orders assigning him/her to a go-to-war unit on a part-time deployment basis.)

Section 2		Military Personnel Only	
<b>Service</b> (Choose only one)			
<input type="checkbox"/> Active Army	<input type="checkbox"/> Army Reserve	<input type="checkbox"/> Air Force Reserve	<input type="checkbox"/> Marine Corps
<input type="checkbox"/> Navy Reserve	<input type="checkbox"/> Air Force	<input type="checkbox"/> Air National Guard	<input type="checkbox"/> Navy
<input type="checkbox"/> Army National Guard	<input type="checkbox"/> Air Force	<input type="checkbox"/> Air National Guard	<input type="checkbox"/> Navy
<input type="checkbox"/> Other			
<b>Career Branch</b> (Choose only one)			
<input type="checkbox"/> AN	<input type="checkbox"/> CM	<input type="checkbox"/> MC	<input type="checkbox"/> NC
<input type="checkbox"/> BSC	<input type="checkbox"/> DC	<input type="checkbox"/> MSC	<input type="checkbox"/> PA
<input type="checkbox"/> SP	<input type="checkbox"/> VC	<input type="checkbox"/> Other	
<b>Rank</b> (Choose only one)			
<input type="checkbox"/> 1LT	<input type="checkbox"/> CDR	<input type="checkbox"/> CSM	<input type="checkbox"/> HMCM
<input type="checkbox"/> LTCOL	<input type="checkbox"/> MSGT	<input type="checkbox"/> SCPO	<input type="checkbox"/> SRA
<input type="checkbox"/> 1SG	<input type="checkbox"/> CMS	<input type="checkbox"/> ENS	<input type="checkbox"/> HMCS
<input type="checkbox"/> LTJG	<input type="checkbox"/> PFC	<input type="checkbox"/> SFC	<input type="checkbox"/> SSG
<input type="checkbox"/> 2LT	<input type="checkbox"/> COL	<input type="checkbox"/> HM1	<input type="checkbox"/> LCDR
<input type="checkbox"/> MAJ	<input type="checkbox"/> PO1	<input type="checkbox"/> SGM	<input type="checkbox"/> SSGT
<input type="checkbox"/> A1C	<input type="checkbox"/> CPL	<input type="checkbox"/> HM2	<input type="checkbox"/> LCPL
<input type="checkbox"/> MCPO	<input type="checkbox"/> PO2	<input type="checkbox"/> SGT	<input type="checkbox"/> TSGT
<input type="checkbox"/> AMN	<input type="checkbox"/> CPO	<input type="checkbox"/> HM3	<input type="checkbox"/> LT
<input type="checkbox"/> MCPON	<input type="checkbox"/> PO3	<input type="checkbox"/> SMS	<input type="checkbox"/> OTHER
<input type="checkbox"/> CAPT	<input type="checkbox"/> CPT	<input type="checkbox"/> HMC	<input type="checkbox"/> LTC
<input type="checkbox"/> MSG	<input type="checkbox"/> PVT	<input type="checkbox"/> SPC	
<b>Are you PROFIS?</b> <input type="checkbox"/> Yes <input type="checkbox"/> No			

## Section 3: Civilian Personnel Only

- This section should be filled out by civilian personnel only.
- Shade in your professional title (select one). If your professional title is not listed, shade in the **Other** bubble.

Section 3		Civilian Personnel Only	
<b>Professional Title</b> (Choose only one)			
<input type="checkbox"/> DO	<input type="checkbox"/> DDS	<input type="checkbox"/> DVM	<input type="checkbox"/> MD
<input type="checkbox"/> PhD	<input type="checkbox"/> RN	<input type="checkbox"/> Other	

## Section 4: Evaluation/Critique

- Use this section to fill in your responses to the 8 Evaluation questions and the 32 examination questions regarding the medical management of chemical agent casualties.

Section 4		Evaluation/Critique	
1 <input type="checkbox"/>	9 <input type="checkbox"/>	17 <input type="checkbox"/>	25 <input type="checkbox"/>
2 <input type="checkbox"/>	10 <input type="checkbox"/>	18 <input type="checkbox"/>	26 <input type="checkbox"/>
3 <input type="checkbox"/>	11 <input type="checkbox"/>	19 <input type="checkbox"/>	27 <input type="checkbox"/>
4 <input type="checkbox"/>	12 <input type="checkbox"/>	20 <input type="checkbox"/>	28 <input type="checkbox"/>
5 <input type="checkbox"/>	13 <input type="checkbox"/>	21 <input type="checkbox"/>	29 <input type="checkbox"/>
6 <input type="checkbox"/>	14 <input type="checkbox"/>	22 <input type="checkbox"/>	30 <input type="checkbox"/>
7 <input type="checkbox"/>	15 <input type="checkbox"/>	23 <input type="checkbox"/>	31 <input type="checkbox"/>
8 <input type="checkbox"/>	16 <input type="checkbox"/>	24 <input type="checkbox"/>	32 <input type="checkbox"/>
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